

What is claimed is:

1. A multi-component fiber having enhanced reversible thermal properties, comprising:
a fiber body formed from a plurality of elongated members, at least one of the elongated members comprising a temperature regulating material dispersed therein.
2. The multi-component fiber of claim 1, wherein the temperature regulating material comprises a phase change material.
3. The multi-component fiber of claim 2, wherein the phase change material is selected from the group consisting of hydrocarbons, hydrated salts, waxes, oils, water, fatty acids, fatty acid esters, dibasic acids, dibasic esters, 1-halides, primary alcohols, aromatic compounds, clathrates, semi-clathrates, gas clathrates, stearic anhydride, ethylene carbonate, polyhydric alcohols, polymers, metals, and mixtures thereof.
4. The multi-component fiber of claim 2, wherein the temperature regulating material further comprises a plurality of microcapsules that contain the phase change material.
5. The multi-component fiber of claim 2, wherein the temperature regulating material further comprises silica particles, zeolite particles, carbon particles, or an absorbent material impregnated with the phase change material.
6. The multi-component fiber of claim 1, wherein the elongated members are arranged in an island-in-sea configuration, a segmented-pie configuration, a core-sheath configuration, a side-by-side configuration, or a striped configuration.
7. The multi-component fiber of claim 1, wherein a cross sectional shape of the fiber body is circular, multi-lobal, octagonal, oval, pentagonal, rectangular, square-shaped, trapezoidal, or triangular.
8. The multi-component fiber of claim 1, wherein the fiber body is between 0.1 and 1000 denier.
9. The multi-component fiber of claim 1, further comprising an additive dispersed within at least one of the elongated members, wherein the additive is selected from the group consisting of

water, surfactants, dispersants, anti-foam agents, antioxidants, thermal stabilizers, light stabilizers, UV stabilizers, microwave absorbing additives, reinforcing fibers, conductive fibers, conductive particles, lubricants, process aids, fire retardants, anti-blocking additives, anti-fogging additives, anti-static additives, anti-microbials, crosslinkers, controlled degradation agents, colorants, pigments, dyes, fluorescent whitening agents, optical brighteners, fillers, coupling agents, reinforcement agents, crystallization agents, nucleation agents, and mixtures thereof.

10. A multi-component fiber having enhanced reversible thermal properties, comprising:

a first elongated member comprising a first polymeric material and a temperature regulating material dispersed within the first polymeric material; and

a second elongated member comprising a second polymeric material, wherein the second elongated member is joined with the first elongated member.

11. The multi-component fiber of claim 10, wherein the temperature regulating material comprises a phase change material.

12. The multi-component fiber of claim 11, wherein the phase change material is a hydrocarbon or a mixture of hydrocarbons.

13. The multi-component fiber of claim 11, wherein the temperature regulating material further comprises a plurality of microcapsules that contain the phase change material.

14. The multi-component fiber of claim 13, wherein the first polymeric material has an affinity for the microcapsules to facilitate dispersing the microcapsules within the first polymeric material.

15. The multi-component fiber of claim 10, wherein the temperature regulating material is a first temperature regulating material, and wherein the second elongated member further comprises a second temperature regulating material dispersed within the second polymeric material.

16. The multi-component fiber of claim 15, wherein the first temperature regulating material and the second temperature regulating material are different.

17. The multi-component fiber of claim 10, wherein the first polymeric material and the second polymeric material are independently selected from the group consisting of polyamides, polyamines, polyimides, polyacrylics, polycarbonates, polydienes, polyepoxides, polyesters, polyethers, polyfluorocarbons, formaldehyde polymers, natural polymers, polyolefins, polyphenylenes, silicon containing polymers, polyurethanes, polyvinyls, polyacetals, polyarylates, copolymers, and mixtures thereof.

18. The multi-component fiber of claim 10, wherein the first polymeric material comprises polyethylene-co-vinyl acetate having between 5 percent and 90 percent by weight of vinyl acetate.

19. The multi-component fiber of claim 10, wherein the first elongated member is surrounded by the second elongated member.

20. The multi-component fiber of claim 19, wherein the first elongated member is positioned within and completely surrounded by the second elongated member.

21. The multi-component fiber of claim 10, wherein the first elongated member comprises from 10 percent to 90 percent of a total weight of the multi-component fiber.

22. The multi-component fiber of claim 10, wherein the multi-component fiber is between 0.1 and 1000 denier.

23. The multi-component fiber of claim 10, further comprising an additive dispersed within at least one of the first polymeric material and the second polymeric material, wherein the additive is selected from the group consisting of water, surfactants, dispersants, anti-foam agents, antioxidants, thermal stabilizers, light stabilizers, UV stabilizers, microwave absorbing additives, reinforcing fibers, conductive fibers, conductive particles, lubricants, process aids, fire retardants, anti-blocking additives, anti-fogging additives, anti-static additives, anti-microbials, crosslinkers, controlled degradation agents, colorants, pigments, dyes, fluorescent whitening agents, optical brighteners, fillers, coupling agents, reinforcement agents, crystallization agents, nucleation agents, and mixtures thereof.

24. A multi-component fiber having enhanced reversible thermal properties, comprising:
a core member comprising a temperature regulating material; and
a sheath member surrounding the core member.

25. The multi-component fiber of claim 24, wherein the temperature regulating material comprises a phase change material.

26. The multi-component fiber of claim 25, wherein the phase change material is selected from the group consisting of hydrocarbons, hydrated salts, waxes, oils, water, fatty acids, fatty acid esters, dibasic acids, dibasic esters, 1-halides, primary alcohols, aromatic compounds, clathrates, semi-clathrates, gas clathrates, stearic anhydride, ethylene carbonate, polyhydric alcohols, polymers, metals, and mixtures thereof.

27. The multi-component fiber of claim 25, wherein the phase change material is a polymeric phase change material.

28. The multi-component fiber of claim 25, wherein the core member further comprises a first polymeric material, wherein the temperature regulating material is dispersed within the first polymeric material, and wherein the sheath member comprises a second polymeric material.

29. The multi-component fiber of claim 28, wherein the temperature regulating material further comprises a containment structure that contains the phase change material, and wherein the containment structure comprises microcapsules, silica particles, zeolite particles, carbon particles, or an absorbent material.

30. The multi-component fiber of claim 28, wherein the first polymeric material has a partial affinity for the phase change material, and wherein the second polymeric material encloses the phase change material within the core member and provides a desired physical property to the multi-component fiber.

31. The multi-component fiber of claim 28, wherein the temperature regulating material is a first temperature regulating material, and wherein the sheath member further comprises a second temperature regulating material dispersed within the second polymeric material.

32. The multi-component fiber of claim 31, wherein the first temperature regulating material and the second temperature regulating material are different.

33. The multi-component fiber of claim 28, wherein the first polymeric material and the second polymeric material are independently selected from the group consisting of polyamides, polyamines, polyimides, polyacrylics, polycarbonates, polydienes, polyepoxides, polyesters, polyethers, polyfluorocarbons, formaldehyde polymers, natural polymers, polyolefins, polyphenylenes, silicon containing polymers, polyurethanes, polyvinyls, polyacetals, polyarylates, copolymers, and mixtures thereof.

34. The multi-component fiber of claim 24, wherein the core member is positioned within and completely surrounded by the sheath member.

35. The multi-component fiber of claim 24, wherein the core member is concentrically positioned within the sheath member.

36. The multi-component fiber of claim 24, wherein the core member is eccentrically positioned within the sheath member.

37. The multi-component fiber of claim 24, wherein a cross sectional shape of the core member is circular, multi-lobal, octagonal, oval, pentagonal, rectangular, square-shaped, trapezoidal, triangular, or wedge-shaped.

38. The multi-component fiber of claim 24, wherein the multi-component fiber is between 0.1 and 1000 denier.

39. The multi-component fiber of claim 24, further comprising an additive dispersed within at least one of the core member and the sheath member, wherein the additive is selected from the group consisting of water, surfactants, dispersants, anti-foam agents, antioxidants, thermal stabilizers, light stabilizers, UV stabilizers, microwave absorbing additives, reinforcing fibers, conductive fibers, conductive particles, lubricants, process aids, fire retardants, anti-blocking additives, anti-fogging additives, anti-static additives, anti-microbials, crosslinkers, controlled degradation agents, colorants, pigments, dyes, fluorescent whitening agents, optical brighteners,

fillers, coupling agents, reinforcement agents, crystallization agents, nucleation agents, and mixtures thereof.

40. A fiber having enhanced reversible thermal properties, comprising:
at least one inner member extending through substantially the length of the fiber and comprising a blend of a first polymeric material and a temperature regulating material; and
an outer member surrounding the inner member and forming the exterior of the fiber, wherein the outer member comprises a second polymeric material.
41. The fiber of claim 40, wherein the first polymeric material and the second polymeric material are independently selected from the group consisting of polyolefins, polyamides, polyesters, elastomeric polymers, and mixtures thereof.
42. The fiber of claim 41, wherein the first polymeric material and the second polymeric material are polyolefins independently selected from the group consisting of polyethylene, polypropylene, and mixtures thereof.
43. The fiber of claim 40, wherein the temperature regulating material absorbs or releases heat at a temperature in the range of -5°C to 125°C.
44. The fiber of claim 40, wherein the temperature regulating material absorbs or releases heat at a temperature in the range of 22°C to 28°C.
45. The fiber of claim 40, wherein the temperature regulating material is a phase change material selected from the group consisting of C₁₀ - C₄₄ paraffinic hydrocarbons, polyethylene oxides, polyethylene glycols, and mixtures thereof.
46. The fiber of claim 40, wherein the temperature regulating material is a solid/solid phase change material.
47. The fiber of claim 40, wherein the inner member comprises two or more different temperature regulating materials.

48. The fiber of claim 40, wherein the inner member comprises up to 50 percent by weight of the temperature regulating material.

49. The fiber of claim 40, wherein the inner member comprises up to 25 percent by weight of the temperature regulating material.

50. The fiber of claim 40, wherein portions of the temperature regulating material are enclosed by the first polymeric material.

51. The fiber of claim 40, wherein the inner member is a single inner member defining a core within the fiber.

52. The fiber of claim 40, wherein the fiber comprises a plurality of inner members separated from each other and surrounded by the outer member.

53. The fiber of claim 40, wherein the fiber is a continuous fiber or a staple fiber.

54. A core/sheath fiber comprising:

a core member positioned within and extending through substantially the length of the fiber, wherein the core member comprises a blend of a first polymeric material and a temperature regulating material; and

a sheath member forming the exterior of the fiber and surrounding the core member, wherein the sheath member comprises a second polymeric material.

55. The core/sheath fiber of claim 54, wherein the first polymeric material and the second polymeric material are independently selected from the group consisting of polyolefins, polyamides, polyesters, elastomeric polymers, and mixtures thereof.

56. The core/sheath fiber of claim 55, wherein the first polymeric material and the second polymeric material are polyolefins independently selected from the group consisting of polyethylene, polypropylene, and mixtures thereof.

57. The core/sheath fiber of claim 54, wherein the temperature regulating material is a phase change material selected from the group consisting of C₁₀ - C₄₄ paraffinic hydrocarbons, polyethylene oxides, polyethylene glycols, and mixtures thereof.

58. The core/sheath fiber of claim 54, wherein the temperature regulating material is a solid/solid phase change material.

59. The core/sheath fiber of claim 54, wherein the core member comprises a blend of the first polymeric material and at least two different temperature regulating materials.

60. An island-in-sea fiber comprising:
a plurality of island members positioned within and extending through substantially the length of the fiber, wherein each of the island members is separated from one another and comprises a blend of an island polymeric material and a temperature regulating material; and
a sea member forming the exterior of the fiber and surrounding each of the island members, wherein the sea member comprises a sea polymeric material.

61. The island-in-sea fiber of claim 60, wherein the island polymeric material and the sea polymeric material are independently selected from the group consisting of polyolefins, polyamides, polyesters, elastomeric polymers, and mixtures thereof.

62. The island-in-sea fiber of claim 61, wherein the island polymeric material and the sea polymeric material are polyolefins independently selected from the group consisting of polyethylene, polypropylene, and mixtures thereof.

63. The island-in-sea fiber of claim 60, wherein the temperature regulating material is a phase change material selected from the group consisting of C₁₀ - C₄₄ paraffinic hydrocarbons, polyethylene oxides, polyethylene glycols, and mixtures thereof.

64. The island-in-sea fiber of claim 60, wherein the temperature regulating material is a solid/solid phase change material.

65. The island-in-sea fiber of claim 60, wherein at least one island member comprises a blend of the island polymeric material and at least two different temperature regulating materials.

66. The island-in-sea fiber of claim 60, wherein at least two island members comprise different temperature regulating materials.

67. The island-in-sea fiber of claim 60, wherein at least two island members comprise different island polymeric materials.

68. A method of manufacturing and processing a fiber having enhanced reversible thermal properties, comprising:

- mixing a temperature regulating material with a first polymeric material so as to form a blend;
- combining the blend with a second polymeric material in a spin pack of a fiber extrusion apparatus such that the second polymeric material surrounds the blend; and
- extruding the blend and the second polymeric material from a spinneret of the spin pack so as to form a fiber having an outer member formed of the second polymeric material and surrounding an inner member formed of the blend.

69. The method of claim 68, further comprising adding the temperature regulating material to the first polymeric material prior to their mixing, wherein each of the temperature regulating material and the first polymeric material is in the form of a liquid or a solid.

70. The method of claim 68, wherein mixing the temperature regulating material with the first polymeric material comprises:

- providing a first liquid stream of the temperature regulating material;
- providing a second liquid stream of the first polymeric material; and
- intersecting the first and second liquid streams so as to form the blend of the temperature regulating material and the first polymeric material.

71. The method of claim 68, wherein extruding the blend and the second polymeric material is performed in a melt spinning process or a solution spinning process.

72. The method of claim 68, further comprising attenuating the fiber.

73. The method of claim 72, further comprising, subsequent to attenuating the fiber, rolling the fiber onto a bobbin or combining the fiber with other fibers so as to form a non-woven web.

74. A method of manufacturing a fiber having enhanced reversible thermal properties, comprising:

forming a plurality of separate blends, wherein each blend comprises a temperature regulating material and a first polymeric material;

combining the plurality of separate blends with a second polymeric material in a spin pack of a fiber extrusion apparatus such that the second polymeric material surrounds the plurality of separate blends; and

extruding the plurality of separate blends and the second polymeric material from a spinneret of the spin pack so as to form a fiber having an outer member formed of the second polymeric material and surrounding a plurality of inner members formed of the plurality of separate blends.

75. The method of claim 74, wherein at least two of the separate blends comprise different temperature regulating materials.

76. A fabric comprising a plurality of fibers blended together, wherein at least one fiber exhibits enhanced reversible thermal properties and comprises:

at least one inner member comprising a blend of a first polymeric material and a temperature regulating material, wherein the inner member extends through substantially the length of the fiber; and

an outer member forming the exterior of the fiber and surrounding the inner member, wherein the outer member comprises a second polymeric material.

77. The fabric of claim 76, wherein the inner member comprises at least two different temperature regulating materials.

78. The fabric of claim 76, wherein the fabric comprises a plurality of fibers exhibiting enhanced reversible thermal properties, and wherein at least two fibers comprise different temperature regulating materials.

79. The fabric of claim 76, wherein the fiber comprises a plurality of inner members surrounded by the outer member.

80. The fabric of claim 79, wherein at least two of the inner members comprise different temperature regulating materials.

81. The fabric of claim 76, wherein the plurality of fibers are blended together by a woven process or a non-woven process.

82. The fabric of claim 76, wherein the plurality of fibers are blended together by a spunbond process.

83. A fabric comprising a plurality of fibers blended together, wherein at least one fiber exhibits enhanced reversible thermal properties and comprises:
a fiber body formed from a plurality of elongated members, at least one of the elongated members comprising a temperature regulating material dispersed therein.

84. The fabric of claim 83, wherein the temperature regulating material comprises a phase change material.

85. The fabric of claim 84, wherein the phase change material is selected from the group consisting of hydrocarbons, hydrated salts, waxes, oils, water, fatty acids, fatty acid esters, dibasic acids, dibasic esters, 1-halides, primary alcohols, aromatic compounds, clathrates, semi-clathrates, gas clathrates, stearic anhydride, ethylene carbonate, polyhydric alcohols, polymers, metals, and mixtures thereof.

86. The fabric of claim 84, wherein the temperature regulating material further comprises a plurality of microcapsules that contain the phase change material.

87. The fabric of claim 84, wherein the temperature regulating material further comprises silica particles, zeolite particles, carbon particles, or an absorbent material impregnated with the phase change material.

88. The fabric of claim 83, wherein the elongated members are arranged in an island-in-sea configuration, a segmented-pie configuration, a core-sheath configuration, a side-by-side configuration, or a striped configuration.

89. The fabric of claim 83, wherein a cross sectional shape of the fiber body is circular, multi-lobal, octagonal, oval, pentagonal, rectangular, square-shaped, trapezoidal, or triangular.

90. The fabric of claim 83, wherein the fiber body is between 0.1 and 1000 denier.

91. The fabric of claim 83, further comprising an additive dispersed within at least one of the elongated members, wherein the additive is selected from the group consisting of water, surfactants, dispersants, anti-foam agents, antioxidants, thermal stabilizers, light stabilizers, UV stabilizers, microwave absorbing additives, reinforcing fibers, conductive fibers, conductive particles, lubricants, process aids, fire retardants, anti-blocking additives, anti-fogging additives, anti-static additives, anti-microbials, crosslinkers, controlled degradation agents, colorants, pigments, dyes, fluorescent whitening agents, optical brighteners, fillers, coupling agents, reinforcement agents, crystallization agents, nucleation agents, and mixtures thereof.

92. The fabric of claim 83, wherein the plurality of fibers are blended together by a woven process, a non-woven process, or a knitted process.